

NON-PUBLIC?: N
ACCESSION #: 9307060296
LICENSEE EVENT REPORT (LER)

FACILITY NAME: SAN ONOFRE NUCLEAR GENERATING STATION, PAGE: 1
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UNIT 2

DOCKET NUMBER: 05000361

TITLE: UNIT 2 MANUAL REACTOR TRIP DUE TO LOSS OF REACTOR
COOLANT
PUMP P004 CONTROLLED BLEEDOFF FLOW
EVENT DATE: 04/10/91 LER #: 91-007-01 REPORT DATE: 07/01/93

OTHER FACILITIES INVOLVED: NONE DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: R. W. Krieger, Station Manager TELEPHONE: (714) 368-6255

COMPONENT FAILURE DESCRIPTION:
CAUSE: B SYSTEM: AB COMPONENT: P MANUFACTURER: B580
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

This revision provides an amended cause assessment and corrective action section based on completion of our root cause evaluation.

At 1606 on April 10, 1991, the Unit 2 reactor was manually tripped on indication of a complete loss of controlled bleedoff (CBO) flow from reactor coolant pump (RCP) P004. P004 was stopped following the trip, and the plant was stabilized in Mode 3 at 1621. Emergency feedwater actuation system (EFAS) signals were generated for both steam generators (SGs) due to the expected SG level "shrink" following the trip.

CBO flow ensures long term integrity of the RCP seals during RCP operation. The loss of CBO flow was due to a shift in position of the

P004 rotating baffle, whose fastening bolts were found to have fractured. The root cause of the failure of the baffle bolts was loss of preload due to thread embedment. Embedment is the plastic deformation of local high spots on the mating portions of threads. When this deformation takes place, the fasteners lose preload and are subject to cyclic stresses that can lead to fatigue failure.

The P004 baffle was inspected, repaired, and re-installed with new bolts. The P004 seal assembly was replaced with an in-kind part. The other three RCP baffles were inspected for similar deficiencies. Three (of six) baffle bolts on RCP P001 were found to have slightly loosened; no loose bolts were identified on the other two RCPs. The baffle bolts for these three RCPs were also replaced with new bolts.

END OF ABSTRACT

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Plant: San Onofre Nuclear Generating Station (SONGS)

Unit: Two

Reactor Vendor: Combustion Engineering

Event Date: 04-10-91

Time: 1606

A. CONDITIONS AT TIME OF THE EVENT:

Mode: 1, Power Operation (100% power)

B. BACKGROUND INFORMATION:

The purpose in this revision is to 1) correct information previously provided which was later determined to be incorrect, and 2) provide the results of our root cause evaluation.

Reactor Coolant Pump (RCP) AB,P! controlled bleedoff (CBO) flow provides cooling and lubrication for the RCP seals SEAL!, and is an essential component in ensuring the design pressure reduction across the seal faces. CBO is reactor coolant which flows up the RCP shaft and past a baffle BAF! (a rotating element of a labyrinth) which is attached to the RCP shaft. CBO water is cooled by-a heat exchanger (a stationary element of a labyrinth), and then flows through the RCP seals. CBO flow ensures long term integrity of the RCP seals during RCP operation. When conditions indicate that a complete loss of CBO flow has occurred, control room operators (utility, licensed) are directed by procedure to manually trip the reactor AC!, and then stop the affected RCP.

C. DESCRIPTION OF THE EVENT:

1. Event:

At 1606 on April 10, 1991, the Unit 2 reactor was manually tripped on indication of a complete loss of CBO flow from RCP P004. P004 was stopped following the trip, and the plant was stabilized in Mode 3 at 1621. A shutdown to Mode 5 (Cold Shutdown) was initiated to repair the RCP seal.

Emergency feedwater actuation system (EFAS) signals were generated for both steam generators (SGs) due to the expected SG level "shrink" following the trip. All EFAS components actuated as designed.

2. Inoperable Structures, Systems or Components that Contributed to the Event:

None

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3. Sequence of Events:

TIME ACTION

1606 The reactor was manually tripped on indication of a complete loss of CBO flow from RCP P004. P004 was stopped following reactor trip.

1621 The plant was stabilized in Mode 3.

4. Method of Discovery:

Control room indications and alarms alerted the control room operators to the loss of CBO flow from P004.

5. Personnel Actions and Analysis of Actions:

Control room operators properly responded in accordance with an approved procedure to manually trip the reactor on indication of total loss of CBO flow to P004.

Control room operators responded properly to the reactor trip, implementing the Emergency Operating Instructions to stabilize

the plant in Mode 3.

Control room operators also properly verified correct system response to the EFAS actuations.

6. Safety System Responses:

The reactor protection system (RPS) and EFAS components actuated as designed.

D. CAUSE OF THE EVENT:

RCP P004 seal and rotating baffle were removed and inspected externally; some wear from rubbing was observed on both the baffle and adjacent components. The six bolts which attach the rotating baffle to the P004 shaft were found to have fractured. Loss of baffle bolt integrity resulted in movement between the RCP shaft and the baffle assembly. This movement adversely affected the CBO flow path through the RCP shaft mechanical seal resulting in the loss of CBO flow.

The root cause of the failure of the baffle bolts was loss of preload due to thread embedment. Embedment is the plastic deformation of local high spots on the mating portions of threads. This deformation normally takes place sometime after torquing of the fasteners. The thread contact and condition of the threads affect the timing of the deformation process. In this case, vibration or other cyclic loading increases the speed of deformation. When this deformation takes place, the fasteners lose preload and are subject to cyclic stresses that can lead to fatigue failure.

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Loss of preload results in a loss of clamping force between the pump shaft and the baffle which allows movement of the baffle. This lateral motion can allow the bolts to back out of the threaded connection which allows the baffle to wobble and apply a cycling force to the bolts. This movement can ultimately result in bolt failure.

E. CORRECTIVE ACTIONS TAKEN:

The P004 baffle was inspected and repaired. The baffle was then re-installed using new bolts. The P004 seal assembly was replaced with an in-kind part.

The other three RCP CBO baffles were inspected for loose or damaged bolts. Three (of six) baffle bolts on RCP P001 were found to have slightly loosened. The baffle bolts for these three RCPs were also replaced with new bolts.

The technique by which the baffle bolts were installed on the RCPs has been improved to require alternately tightening and loosening to provide assurance of effective bolt thread engagement and to prevent embedment relaxation. This "antiembedment" technique has been effective in the aerospace industry in preventing high-strength fastener failures in high-vibration service.

The procedure for disassembly, inspection and assembly of the RCPs was revised to include the use of this anti-embedment technique for installation of the baffle bolts.

F. SAFETY SIGNIFICANCE OF THE EVENT:

There is no safety significance to this event since all RPS and EFAS components actuated in accordance with design.

G. ADDITIONAL INFORMATION:

1. Component Failure Information:

The reactor coolant pumps were manufactured by Byron Jackson.

2. Previous LERs for Similar Events:

None

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